Micro-Fibrillated Cellulose (MFC) – Progress Towards Continuous Production

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Microfibrillated cellulose (MFC)

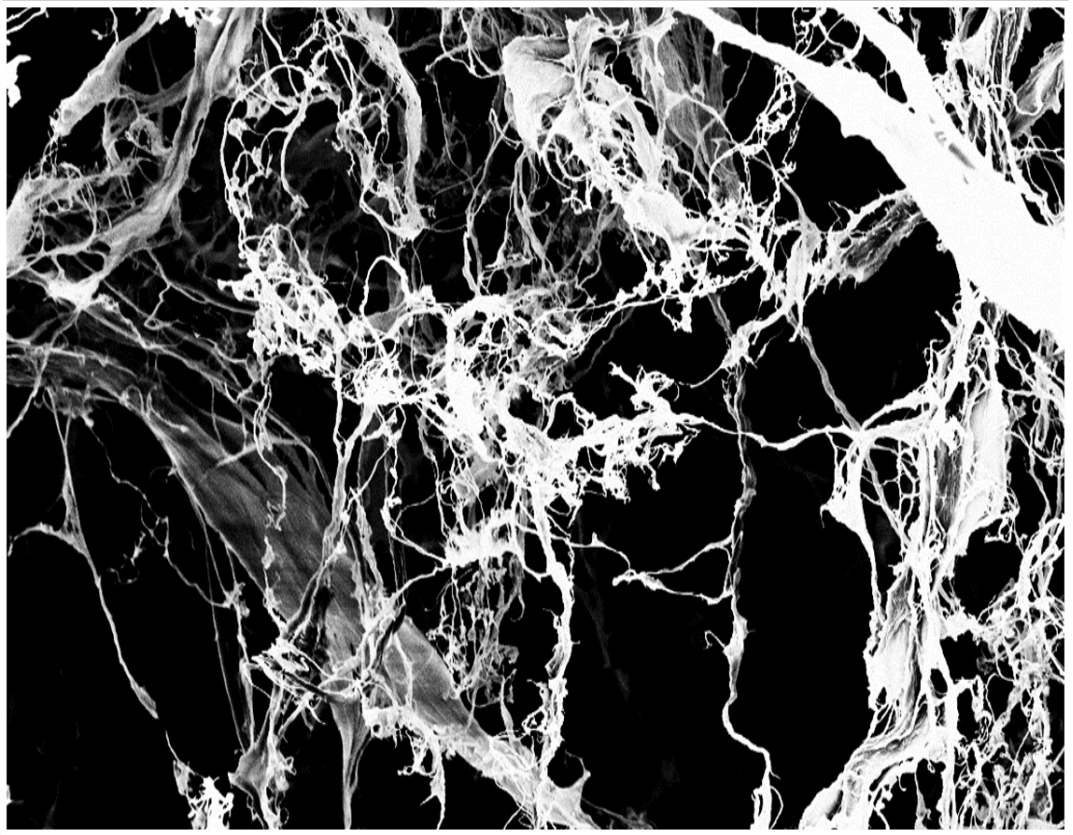
What is it?

MFC has been highly refined using mechanical energy only.

Fiber is often defined by either:

- % total fines (% less than 0.2 mm & 5-75 µm width), or
- as A fines (<0.2 mm in length & 0-75 µm width) and B fines (0.2-7.6 mm in length & 0-5 µm width)

We typically produce pulps that are 65%-95% total fines.



Microfibrillated cellulose (MFC)

Possible benefits for papermakers

- Create a new more profitable grade.
  - MFC would be part of the total grade build.
- Make an existing grade stronger or improved in some way.
- Remove a specific fiber type and substitute MFC.
  - Replace an expensive or less available fiber.
- Possible light-weighting of packaging grades.
- Removal of strength chemistries.
- Enhancement of barrier chemicals.

Production &Refining of MFC

Commercial quantities can be produced using traditional refining technology

Double Disk Refiners

Conical or Modified Conical Refiners

Refining Stage 1 – Double Disk

Fiber Analyzer References

University of Maine's Morphi device will be referred to as Tester 1.

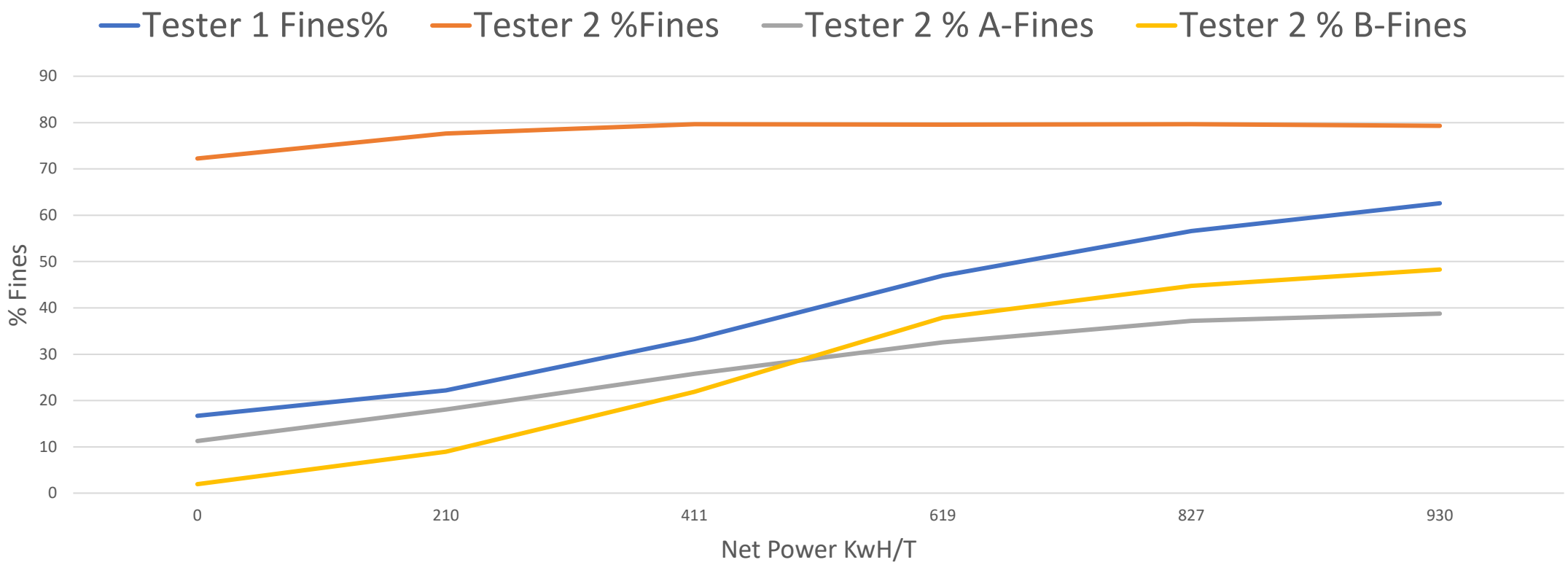
Valmet's FS5 device will be referred to as Tester 2. Only Tester 2 will display Total, A, & B Fines previously defined on slide 2.

PDC Tank Arrangement

Tank 7 is used as the process tank.

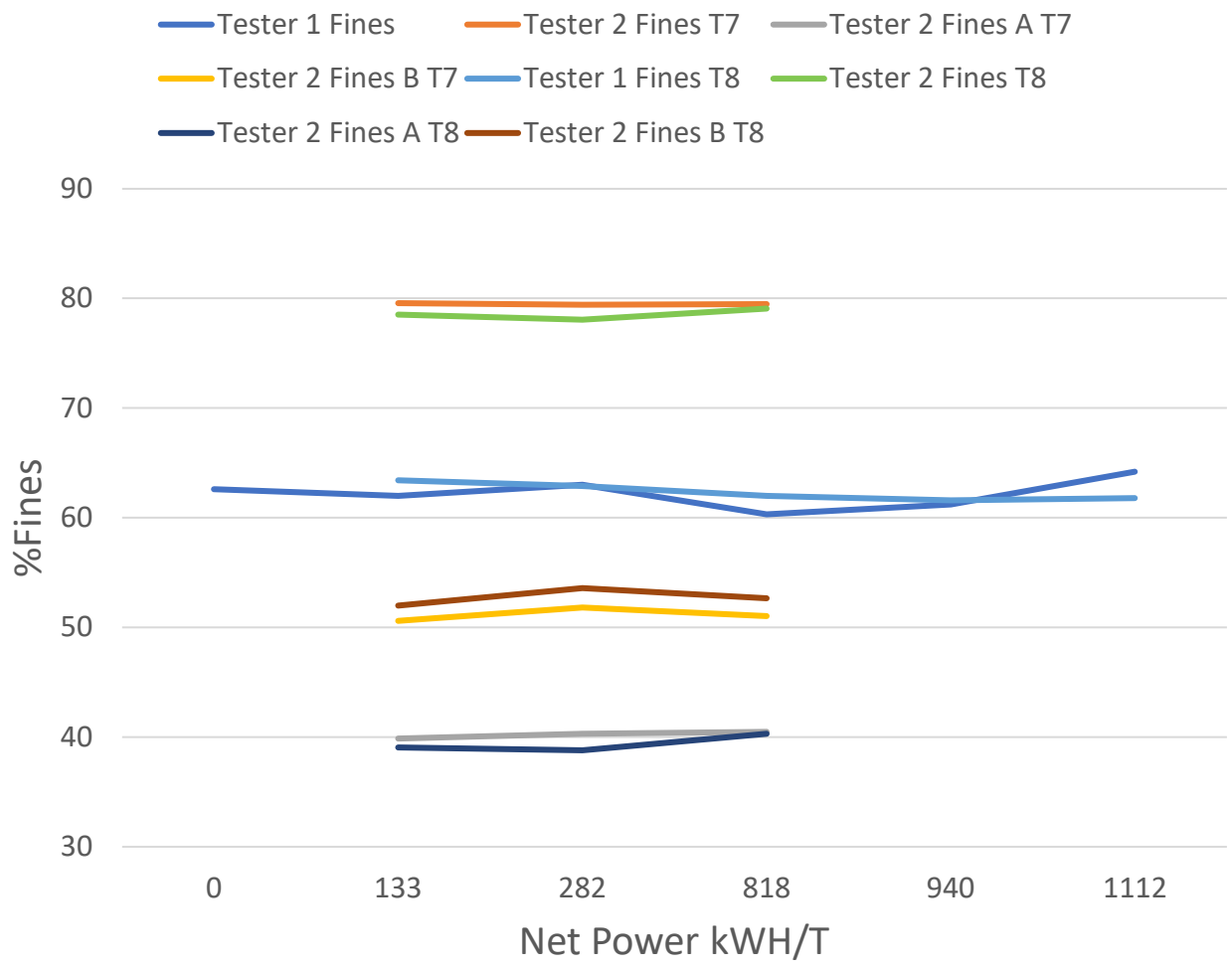
Tank 8 is the storage or “push” tank.

Stage 1 Refining
Double Disk



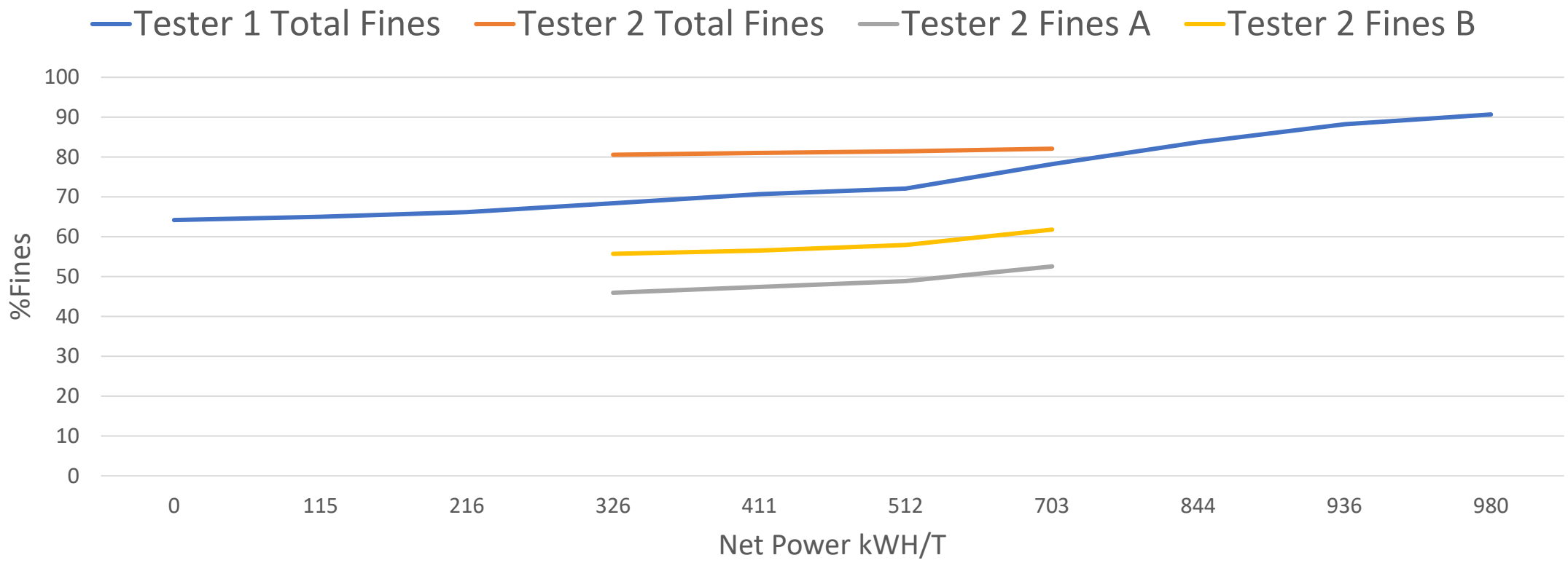
Low Fines Continuous Production – Double Disk

- Tank 7 is finished with stage 1 refining.
- Add new pulp into tank 7 while pulling out an equal flow into tank 8.
- Goal is to end up with 2 tanks of equal fines.
- We finished stage 1 with a 130 kW refiner loading. With the new pulp addition, we were able to raise the loading to 175 kW. NL is 74 kW.
- Pushed 3% (12 gpm) forward while we filled tank 8.



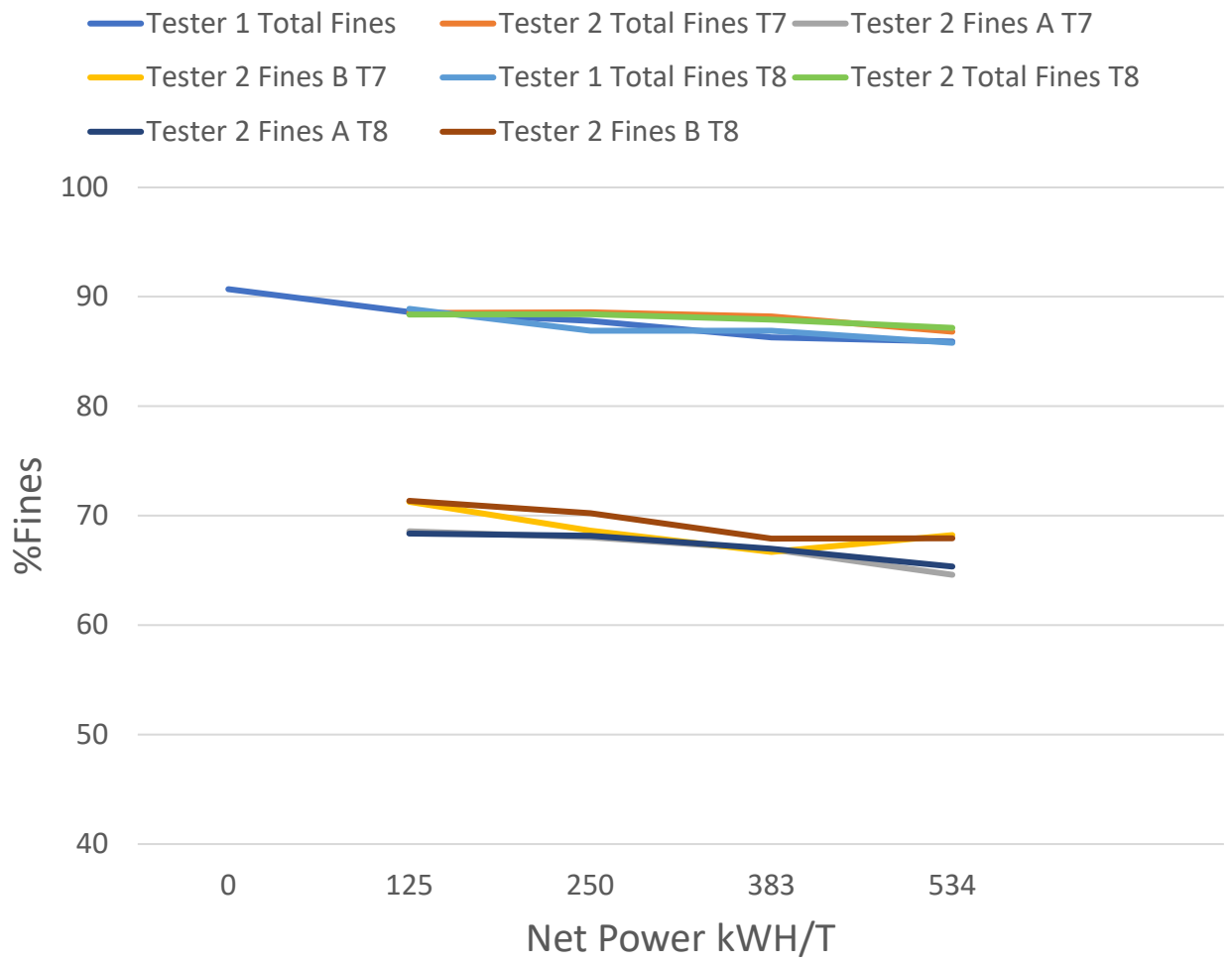
Refining Stage 2 – Double Disk

Stage 2 Refining
Double Disk



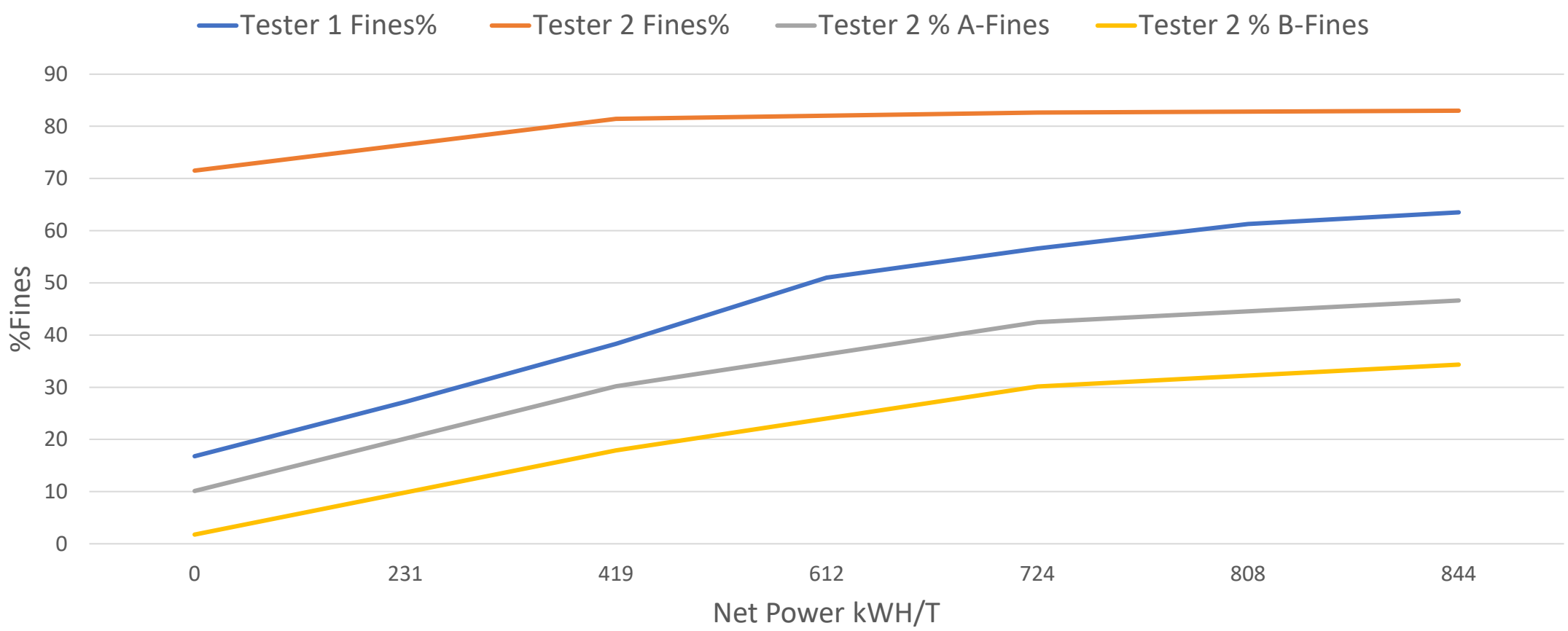
High Fines Continuous Production – Double Disk

- Tank 7 is finished with stage 2 refining.
- Add stage 1 pulp into tank 7 while pulling out an equal flow into tank 8.
- Goal is to end up with 2 tanks of equal fines.
- We finished stage 2 with a 170 kW refiner loading. With the new pulp addition, we were not able to raise the loading. We finished with a loading of 152 kW. NL is 65 kW.
- Pushed 2%-2.5% (8-10 gpm) forward while we filled tank 8.



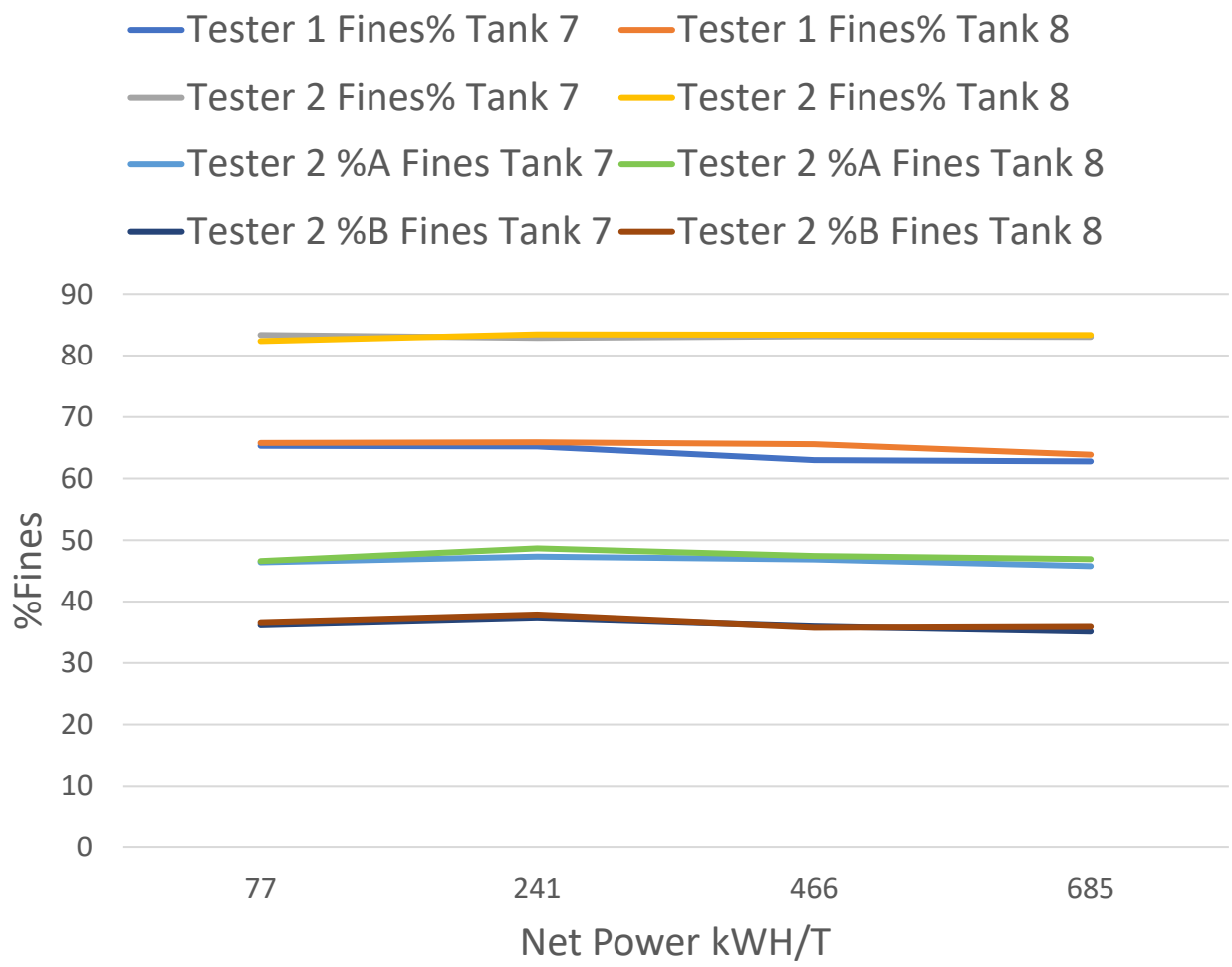
Refining Stage 1 – Modified Conical

Stage 1 Refining
Modified Conical



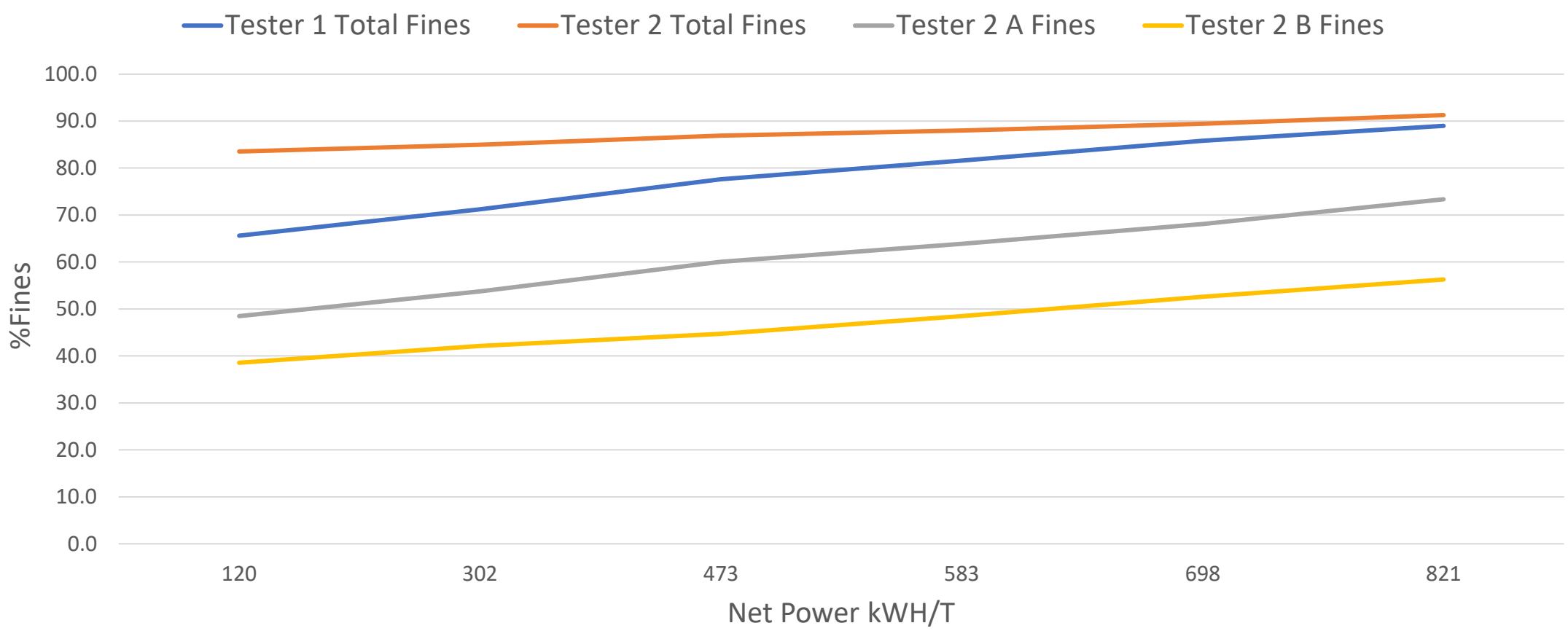
Low Fines Continuous Production – Modified Conical

- Tank 7 is finished with stage 1 refining.
- Add new pulp into tank 7 while pulling out an equal flow into tank 8.
- Goal is to end up with 2 tanks of equal fines.
- We finished stage 1 with a 112 kW refiner loading. With the new pulp addition, we were able to raise the loading to 148 kW. NL is 40 kW.
- Pushed 4% (14 gpm) forward while we filled tank 8.



Refining Stage 2 – Modified Conical

Stage 2 Refining
Modified Conical



High Fines Continuous Production – Modified Conical

- Tank 7 is finished with stage 2 refining.
- Add stage 1 pulp into tank 7 while pulling out an equal flow into tank 8.
- Goal is to end up with 2 tanks of equal fines.
- We finished stage 2 with a 90 kW refiner loading. With the new pulp addition, we were only able to raise the loading to 101 kW. NL is 35 kW.
- Pushed 4% (12 gpm) forward while we filled tank 8. We were not able to hold the %Fines level.

Production Summary

The runs were done several months apart with the same pulp (SCA SW) and same batch size.

Double Disc refining has an equal split between stage 1 and stage 2.

Modified Conical refines to a lower fines level in stage 1 before pulp is pushed to stage 2.

Total time refining were close to equal for both equipment types.

A different production design for the modified conical would be required due to the unequal refining times from stage 1 vs. stage 2.

Conclusions

- For low to medium fines production, continuous is a solution.
- Once power and fiber feed are balanced, production is very stable.
- Continuous production allows for a smaller capital expense and smoother supply.

Double Disk

- For the high fines level, we were not able to apply enough power to hold our fiber “push”.
- The high fines level the production process was less stable.
- More power was used than the modified conical refiner.

Modified Conical

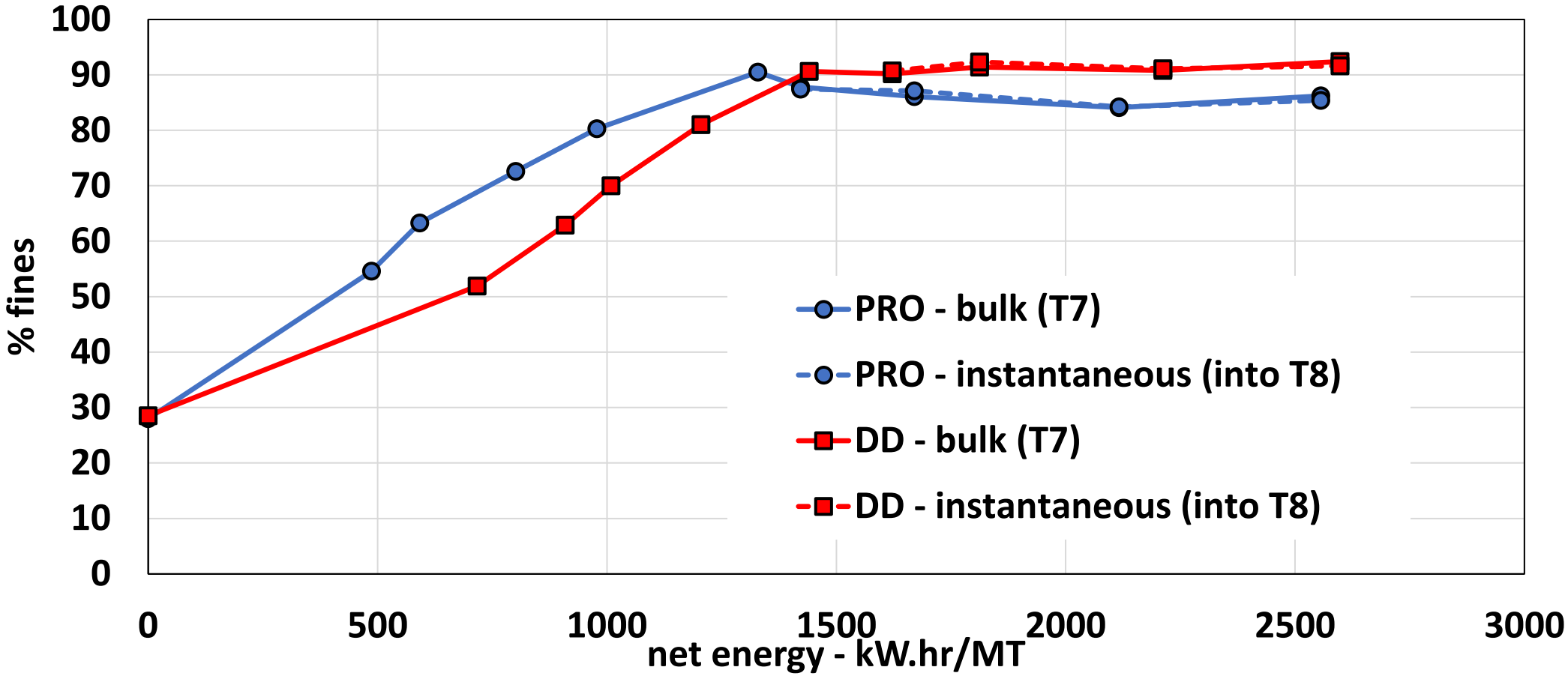
- We were not able to hold our fines level for our fiber “push”.
- The process was stable with some possible control modifications to improve the production.
- Less power was used than the DD refiner mostly due to higher no load.

Additional Semi-Continuous Run

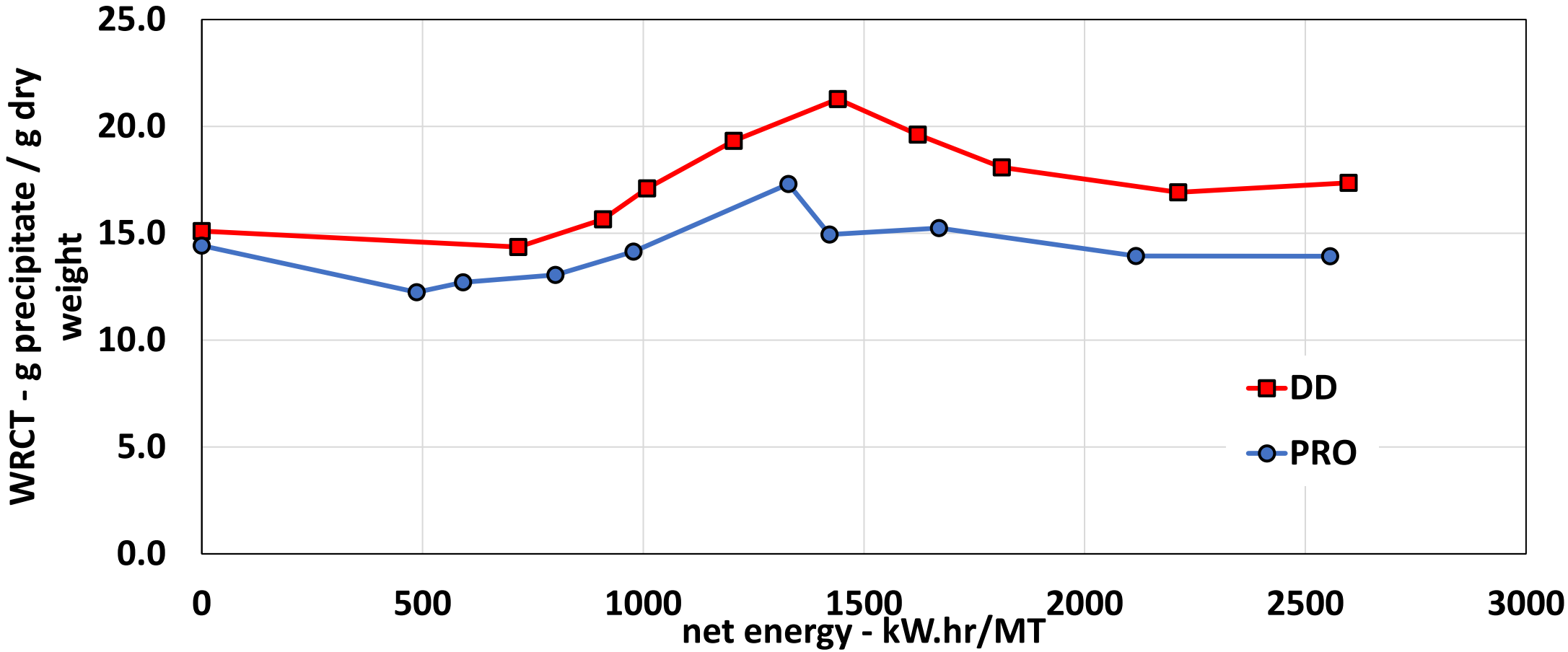
University of Maine – PDC

Hardwood Mix

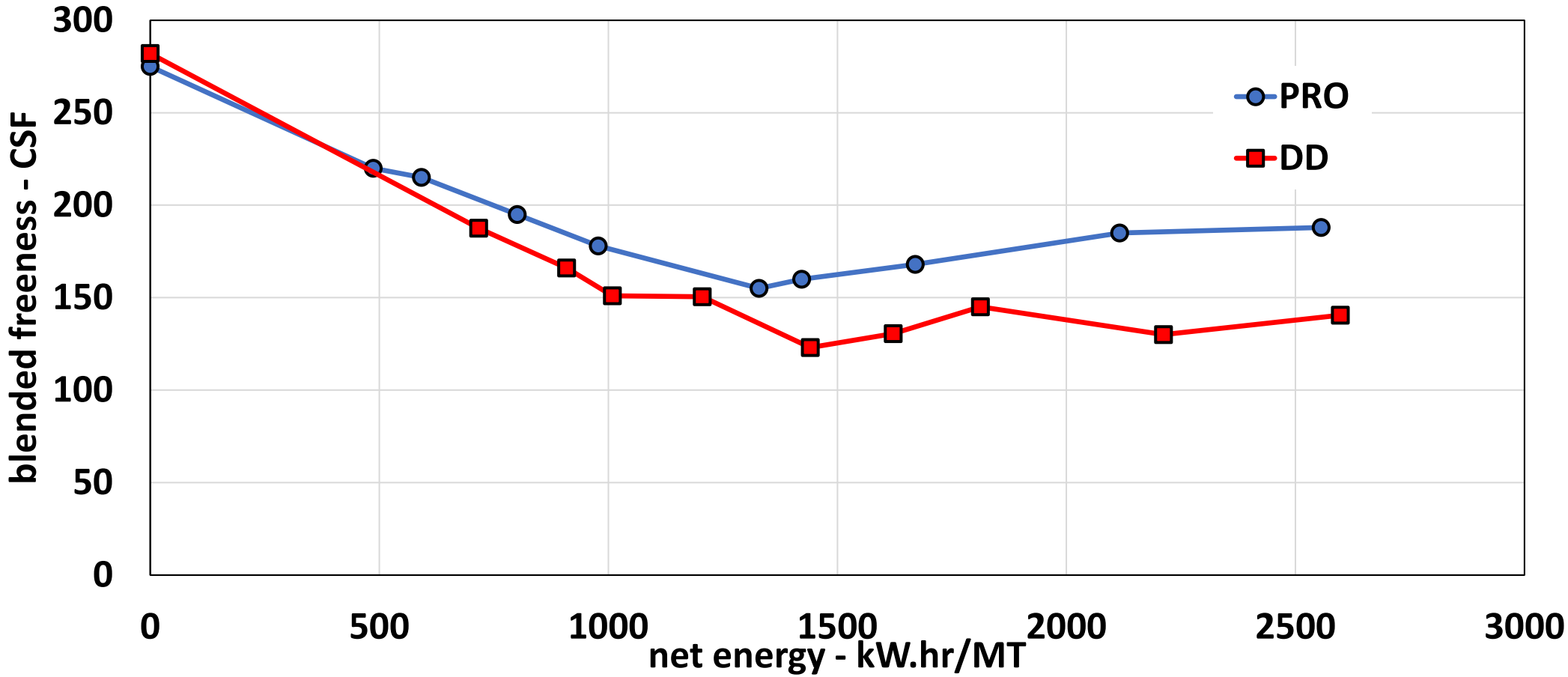
Net Power kWH/T



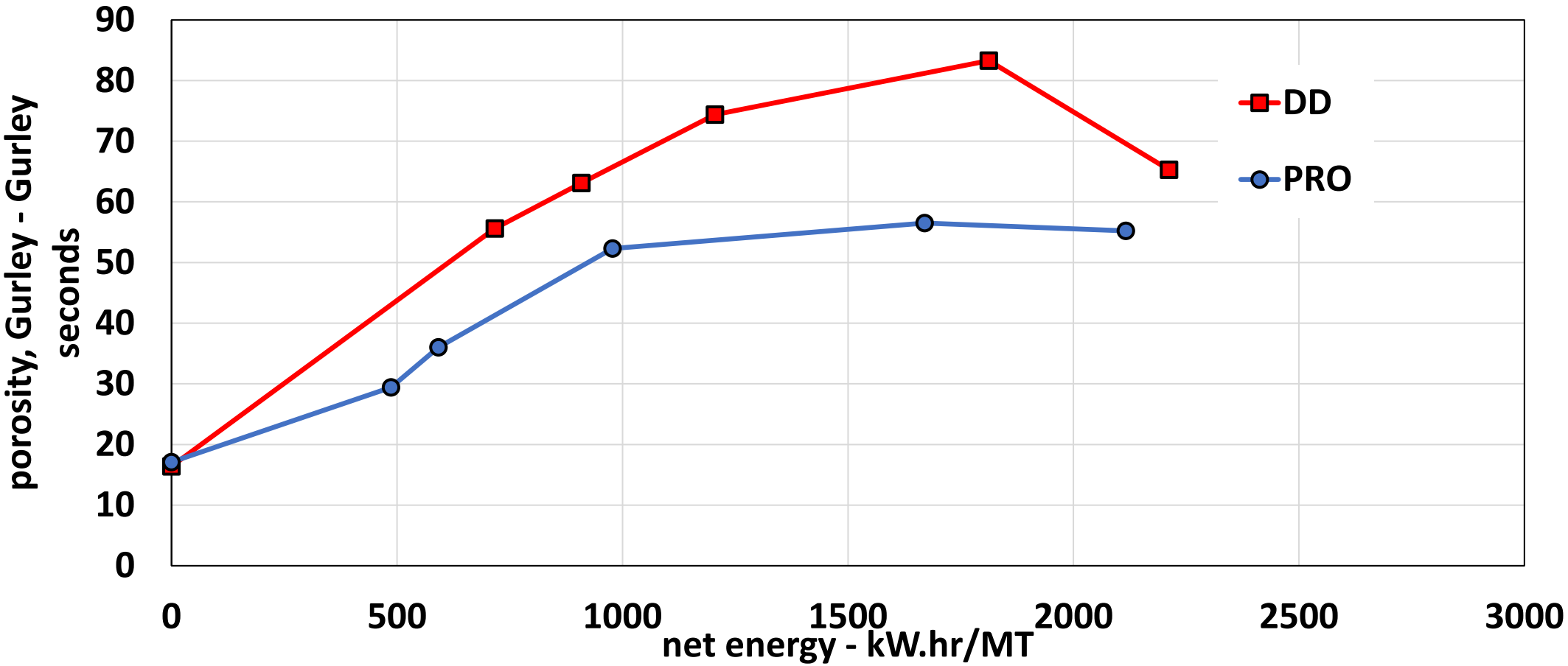
Water Retention



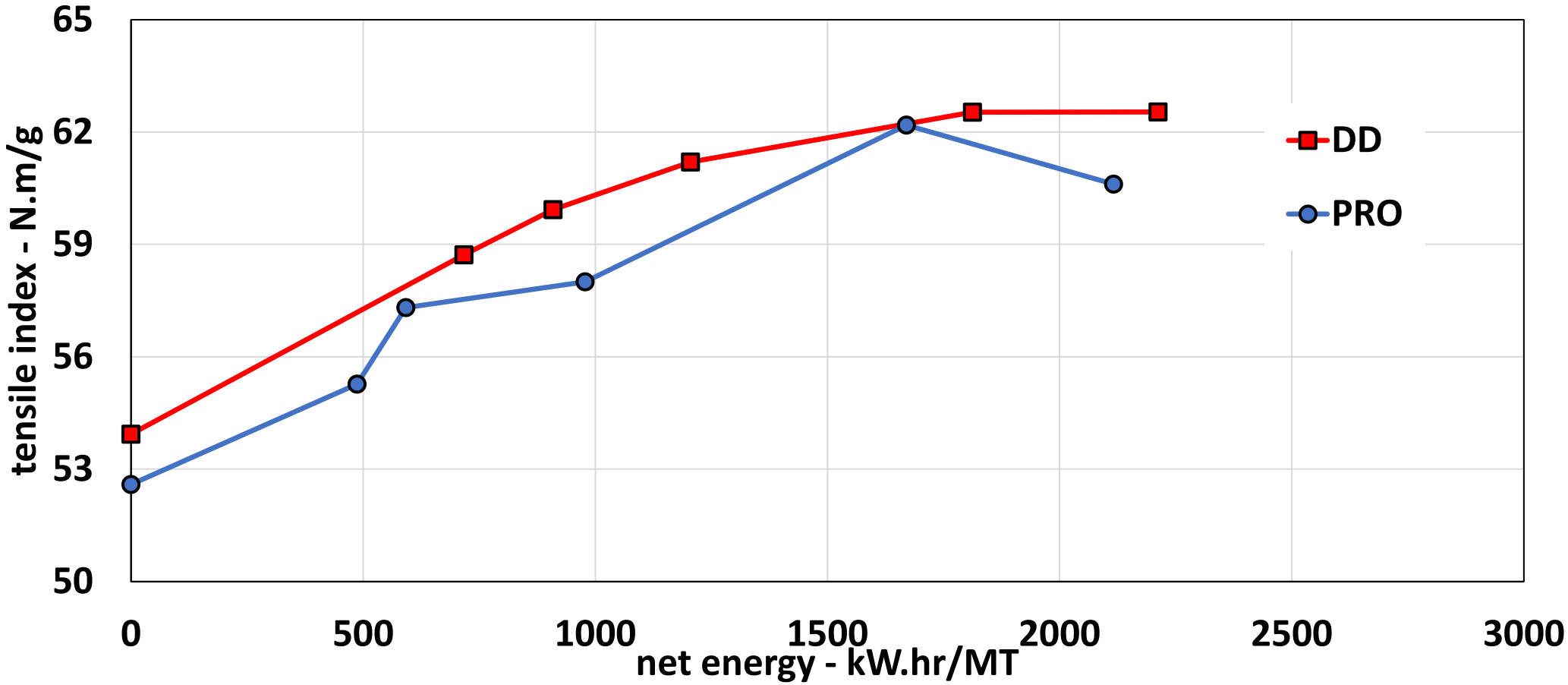
Blended Freeness 5% MFC



Gurley Porosity



Tensile Index



Conclusions

Both refiners created MFC product that was acceptable.

The DD refiner appeared to produce a slightly better product based upon sheet tests.

This MFC was produced using one filling or plate design.

Questions?

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